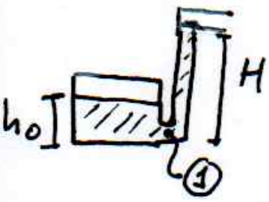
P1 a) $P_{min} \Rightarrow$ El fluido llega a H cl $v_S = 0$,



$$P_1 = P_C + \rho g h_0$$
$$P_1 = P_0 + \rho g H$$
$$\Rightarrow P_C = P_0 + \rho g (H - h_0)$$
$$\boxed{P_{min} = 158{,}165\ kPa}$$

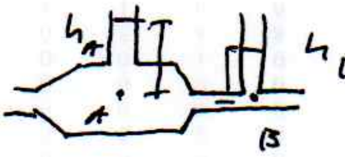
b) cl $P_C > P_{min} \Rightarrow v_S \neq 0$. $P_C = 220\ kPa > P_{min}$ ✓

$$P_C + \rho g h_0 + \frac{1}{2}\rho \cancel{v_C}^2 = P_0 + \rho g H + \frac{1}{2}\rho v_S^2$$
$\to 0$ $h_0 \approx cte$

$$v_S = \sqrt{\frac{2}{\rho}(P_C - P_{min})} \Rightarrow \boxed{v_S = 11{,}12\ m/s}$$

$$Q = v_S \cdot \frac{\pi}{4} d_B^2 \Rightarrow \boxed{Q = 7.86 \times 10^{-3}\ m^3/s}$$

c) En presencia de flujo:



$$P_A + \frac{1}{2}\rho v_A^2 = P_B + \frac{1}{2}\rho v_B^2$$

$$v_B = v_S \qquad v_S \cdot d_B^2 = v_A d_A^2 \Rightarrow v_A = \left(\frac{d_B}{d_A}\right)^2 \cdot v_S$$

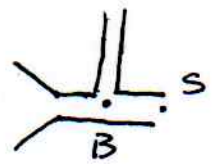
$$P_A - P_B = \frac{1}{2}\rho v_S^2 \left[1 - \left(\frac{d_B}{d_A}\right)^4\right]$$

$$\left.\begin{array}{l} P_A = P_0 + \rho g h_A \\ P_B = P_0 + \rho g h_B \end{array}\right\} P_A - P_B = \rho g \underbrace{(h_A - h_B)}_{\Delta h} \Rightarrow \Delta h = \frac{v_S^2}{2g}\left[1 - \left(\frac{d_B}{d_A}\right)^4\right]$$

$\boxed{\Delta h = 5{,}49\ m} > 0 \Rightarrow h_A > h_B$. Correcto $\because v_A < v_B$

P.q. $d_A > d_B$ y $P_A > P_B$ por el T. Bernoulli.

d)



$$P_B + \frac{1}{2}\rho v_B^2 = P_0 + \frac{1}{2}\rho v_S^2 \Rightarrow P_B = P_0$$

$$\Rightarrow \boxed{h_B = 0}$$

P2 | $n = 10$, diatómico $\Rightarrow$ G.L. $= 5$ $\quad c_V = \frac{5}{2}R$

$c_P = \frac{7}{2}R$

$\gamma = c_P / c_V = \frac{7}{5} = 1{,}4$

a)

	P (kPa)	V ($\times 10^{-3}\ m^3$)	T (K)
A	510	249	1528,2
B	204,07	479	1176,3
C	105	931	1176,3
D	105	249	314

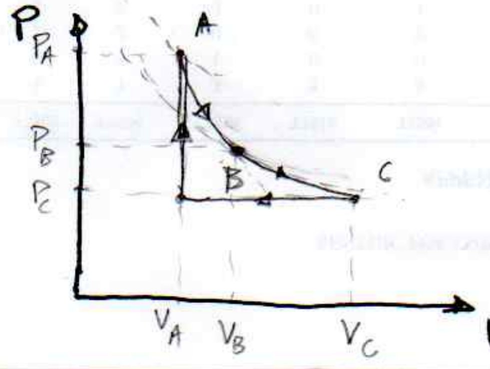
$\boxed{T_A = \frac{P_A V_A}{nR}}$; A-B - Adiabático $\quad P_A V_A^{\gamma} = P_B V_B^{\gamma}$

$\boxed{P_B = P_A \left(\frac{V_A}{V_B}\right)^{\gamma}}$ $\quad \boxed{T_B = \frac{P_B V_B}{nR}}$ $\quad \boxed{T_C = T_B}$, B-C - Isotérmico

$P_B V_B = P_C V_C \Rightarrow \boxed{V_C = \left(\frac{P_B}{P_C}\right) V_B}$

C-D - Isóbaro $\quad P_D = P_C$ $\quad \boxed{T_D = \frac{P_D V_D}{nR}}$

b)



d) Ciclo horario $\Rightarrow$ M. T.

$|W_{A \to C}| > |W_{C \to B}|$

$W_{A \to C} < 0$; $W_{C \to B} > 0$

$\Rightarrow W_{neto} < 0$!

c)

	Q (kJ)	W (kJ)	(kJ) ΔU
A-B	0	-73,1	-73,1
B-C	65,0	-65,0	0
C-D	-250,6	71,6	-179,0
D-A	252,1	0	252,1

$$\boxed{\Delta U = Q + W}$$

A-B: Adiabático $Q_{AB} = 0$

$$W_{AB} = \Delta U_{AB} = nC_V(T_B - T_A) = -73,1 \text{ kJ}$$

B-C Isotérmico $W_{BC} = -nRT_B \ln\left(\frac{V_C}{V_B}\right) = -65 \text{ kJ}$

$$\Delta U_{BC} = 0$$

$$Q_{BC} = -W_{BC}$$

C-D: Isóbaro;

$$Q_{CD} = nC_P(T_D - T_C) = -250,6 \text{ kJ}$$

$$W_{CD} = -P_C(V_D - V_C) = 71,6 \text{ kJ}$$

$$\Delta U_{CD} = Q_{CD} + W_{CD} = nC_V(T_D - T_C) = -179,0 \text{ kJ}$$

D-A: Isócoro;

$$Q_{DA} = nC_V(T_A - T_D) = 252,1 \text{ kJ}$$

$$W_{DA} = 0 \qquad \Delta U_{DA} = Q_{DA}$$

d) CICLO: Chequeo 4/ $\Delta U_{AB} + \Delta U_{BC} + \Delta U_{CD} + \Delta U_{DA} = 0$ ✓

$$W_{Neto} = W_{AB} + W_{BC} + W_{CD} = -66,45 \text{ kJ} < 0 \Rightarrow \text{M.T.}$$

e) Eficiencia: $\eta = \dfrac{W}{Q_H} = 1 - \dfrac{Q_L}{Q_H}$

$Q_L = Q_{CD} < 0$

$Q_H = Q_{BC} + Q_{DA} > 0 \Rightarrow \boxed{\eta = 0{,}21}$

Maq. de Carnot: $\left.\begin{array}{l} T_L = 314\ K \\ T_H = 1528{,}2\ K \end{array}\right\}$ Extremos del Ciclo

$\eta_C = 1 - \dfrac{T_L}{T_H} \Rightarrow \boxed{\eta_C = 0{,}79}$ Esta es la máxima eficiencia del ciclo

f) $\Delta S_U = \underbrace{\Delta S_{sist}}_{\substack{=0 \\ \text{ciclo}}} + \Delta S_H + \Delta S_L$

$\Delta S_H = -\dfrac{(Q_{BC} + Q_{DA})}{T_A} = -207{,}5\ J/K$

$\Delta S_L = -\dfrac{(Q_{CD})}{T_D} = 796{,}6\ J/K$

$\boxed{\Delta S_U = 589{,}1\ J/K > 0}$

P3 I.a) $Y_R(x,t) = A\{\cos(kx - \omega t + \delta) - \cos(kx + \omega t + \delta)\}$

sentido $x>0$ — Inv. de fase en la reflexión — $x<0$

En el argumento de los cosenos,

$a = kx + \delta$
$b = \omega t$
y uso la fórmula de suma

$Y_R = A\{\cancel{\cos(kx+\delta)\cos\omega t} + \sin(kx+\delta)\sin\omega t$

$\quad - \cancel{\cos(kx+\delta)\cos\omega t} + \sin(kx+\delta)\sin\omega t\}$

$$\boxed{Y_R = 2A\sin(kx+\delta).\sin\omega t}$$

No tiene la forma $f(x-vt)$, sino que $f(x).g(t) \Rightarrow$ Onda Estacionaria.

I.b) Para $\forall t$ $\quad Y_R(x) \propto 2A\sin(kx+\delta)$

p/ $x=0$ $\quad Y(0)=0 \Rightarrow Y(0) = 2A\sin\delta = 0 \Rightarrow \boxed{\delta=0}$

$x=L$ $\quad Y(L)=0 \Rightarrow Y(L) = 2A\sin(kL) = 0$

$kL = m.\pi \quad ; \quad m = 1, 2, 3, \ldots$

$\frac{2\pi}{\lambda_m} L = m\pi \Rightarrow \boxed{\lambda_m = \frac{2L}{m}}$

$v = \lambda_m \nu \quad \Rightarrow \quad \sqrt{\frac{T}{\mu}} = \frac{2L}{m}.\nu$

$v = \sqrt{\frac{T}{\mu}}$

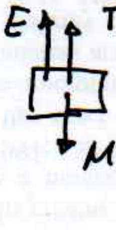
$$\boxed{\nu_m = \frac{m}{2L}\sqrt{\frac{T}{\mu}}}$$

II. a) $\nu = 140\ Hz \qquad T = Mg$

$m = 2$

$$\nu = \frac{1}{L}\sqrt{\frac{Mg}{\mu}} \Rightarrow M = \frac{\mu}{g}(L\nu)^2 \Rightarrow \boxed{M = 900\ g}$$

b)



$$T' + E = Mg \Rightarrow T' = Mg - E$$

$$E = \rho \cdot V_s\, g$$

$T' \Rightarrow \nu = 140\ Hz$ y $m = 3$

$$\nu = \frac{1}{L}\sqrt{\frac{Mg}{\mu}} \leftrightarrow \nu = \frac{3}{2L}\sqrt{\frac{T'}{\mu}}$$

$$\frac{3}{2}\sqrt{\frac{T'}{\mu}} = \sqrt{\frac{Mg}{\mu}} \Rightarrow \boxed{T' = \frac{4}{9}Mg}$$

$$\rho V_s g = Mg - T' = Mg - \frac{4}{9}Mg = \frac{5}{9}Mg$$

$$\rho V_s = \frac{5}{9}M \Rightarrow V_s = \frac{5}{9}\frac{M}{\rho} \Rightarrow \boxed{V_s = 0{,}5\ lt}$$

$$\frac{V_s}{V_c} = 0{,}5 = 50\%$$

c) Para aumentar ν manteniendo el mismo modo 'm' es preciso aumentar la tensión, por lo tanto reducir el empuje, por lo tanto ρ menor < ρ agua.